PL-TR-96-2272

A GUIDE TO REQDATA: AUTOMATED REQUESTING AND PARSING OF GSE FORMATTED DATA

Ivan Henson
Lori Grant

Multimax, Inc.
1441 McCormick Drive
Largo, MD 20774

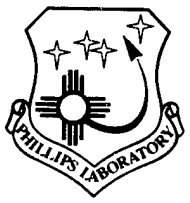
4 October 1996

Scientific Report No. 2

19961223 091

Approved for public release; distribution unlimited.

DTIC QUALITY INSPECTED 4



PHILLIPS LABORATORY
Directorate of Geophysics
AIR FORCE MATERIEL COMMAND
HANSCOM AFB, MA 01731-3010

DEPARTMENT OF ENERGY
OFFICE OF NON-PROLIFERATION AND NATIONAL SECURITY
WASHINGTON, DC 20585

SPONSORED BY
Department of Energy
Office of Non-Proliferation and National Security

MONITORED BY
Phillips Laboratory
CONTRACT No. F19628-95-C-0094

The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the official policies, either express or implied, of the Air Force or U.S. Government.

This technical report has been reviewed and is approved for publication.

DELAINE R. REITER
Contract Manager
Earth Sciences Division

JAMES F. LEWKOWICZ
Director
Earth Sciences Division

This report has been reviewed by the ESD Public Affairs Office (PA) and is releasable to the National Technical Information Service (NTIS).

Qualifed requestors may obtain copies from the Defense Technical Information Center. All others should apply to the National Technical Information Service.

If your address has changed, or you wish to be removed from the mailing list, or if the addressee is no longer employed by your organization, please notify PL/IM, 29 Randolph Road, Hanscom AFB, MA 01731-3010. This will assist us in maintaining a current mailing list.

Do not return copies of this report unless contractual obligations or notices on a specific document requires that it be returned.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	4 October 1996	Scientific No. 2

4. TITLE AND SUBTITLE
A Guide to ReqData: Automated Requesting and Parsing of GSE Formatted Data

5. FUNDING NUMBERS
PE 69120H
PR DENN
TA GM
WU AW
F19628-95-C-0094

6. AUTHOR(S)
Ivan Henson and Lori Grant

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Multimax, Inc.
1441 McCormick Drive
Largo, MD 20774

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Phillips Laboratory
29 Randolph Road
Hanscom AFB, MA 01731-3010
Contract Manager: Delaine Reiter/GPE

10. SPONSORING / MONITORING AGENCY REPORT NUMBER
PL-TR-96-2272

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This document is a guide to a set of programs that can be used to submit GSE2.0 formatted waveform requests to an autoDRM site and automatically parse the email responses. Given an event time and location, travel times are used to compute request-time-windows for a list of stations. Waveform data received in GSE2.0 format are converted to CSS3.0 format and stored in a user-defined directory structure. Multiple requests for separate events can be submitted simultaneously. The status of multiple requests can be monitored through the system's log files. A GUI to the log files is included.

14. SUBJECT TERMS	15. NUMBER OF PAGES
seismic waveforms; autoDRM; GSE 2.0 format; CSS 3.0 format	32
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	SAR

Contents

Introduction 1

Installation 3
- Getting The Package . . . 3
- Activating Automatic Email Parsing . . . 4
- Optional Installation Step . . . 5
- Testing The Installation . . . 5

Sending Requests 7
- Basic Operation . . . 7
- Optional Arguments to `ReqData` . . . 9
- Updating Station Information with reqchan . . . 12

Managing Requests 12
- Basic Operation . . . 12
- Reqstat Options . . . 15
  - Main Window . . . 15
  - Station Request Window . . . 17
  - Confirm Re-request Window . . . 17

Handling Errors 18

Acknowledgments 22

Reference List 22

List of Figures

1 The main window of `reqstat`. All requested events are listed. . . . 14
2 The `reqstat` station request window. The status of each station/channel request for one event is displayed. . . . 14
3 The `reqstat` messages window. A copy of the autoDRM-formatted request is followed by information resulting from the processing of the autoDRM response. . . . 16

INTRODUCTION

This document describes ReqData, a package for requesting and receiving seismic waveform data from Internet sites running an autoDRM [1] (automatic Data Request Manager; Kradolfer, 1993). The ReqData package simplifies the task of formatting the email requests for the user's list of events and stations. ReqData automatically parses the email responses from the autoDRM, converts GSE2.0 format to CSS3.0 and installs data in directories as specified by the user. Also included with ReqData is a GUI for managing the progress of the responses. To help manage station files, two programs are included in the ReqData package: one for querying the autoDRM about stations and one to parse the responses into CSS3.0 station files.

Parameters to the waveform request program, `reqdata` are: an approximate time and location of events to request, a list of stations and channels to request and the directory in which to install the data. To limit the size of the individual email responses, requests are formed separately for each station. A status file and a log file are created in the data directory using the data prefix specified by the user. The log file initially contains a copy of the autoDRM-formatted email requests sent to the specified autoDRM site. The status file records the requested times for each channel, the date of the request and the status (`waiting`, `received-data`, `no-data-available`, etc.). As email responses are received from the autoDRM, both the log and status files are updated.

The log and status files are ASCII text and can be viewed by hand. An X-Windows program, `reqstat`, is provided as a convenient tool for viewing these files. With `reqstat`, the user can easily see the status of all event-requests and the status of all individual channel-requests. From `reqstat`, requests can be resubmitted to the same or a different autoDRM site.

The software that automatically parses GSE2.0-formatted responses from an autoDRM consists of three parts: a mail delivery program named `deliver`[2], the shell script that controls `deliver`, named `.deliver`, and the conversion programs `gse2css` and `gse2site`.

After ReqData is installed, a user's incoming email is automatically filtered by the `.deliver` script to catch all GSE2.0 formatted messages. These messages are removed from the user's email and processed by ReqData conversion programs. All

[1] Since no strict standards exist for autoDRM, ReqData may not work equally well at all sites. ReqData was designed and tested primarily with the autoDRM implemented at USGS and uses GSE2.0 autoDRM commands defined in CRP 243.

[2] Chip Salzenberg, ComDev/TC Telemanagement

messages not recognized as GSE2.0 are forwarded to the user's regular mailbox.

At the time of request, each request is logged and given a unique request-id that is returned by the autoDRM as the REF_ID in the email response. The REF_ID allows the email parsing programs to match incoming data with the request-ids and install the data in the appropriate directory.

The `.deliver` script compares the REF_ID of each GSE2.0 message to the request log created by `reqdata`. If the REF_ID is valid, a conversion program is executed to process the message. If the REF_ID of a GSE2.0 message is not found in the request log, the message is forwarded to the user's regular mailbox. It is an installation option to have all processed GSE2.0 email messages either saved in a file or discarded. When any message fails to be processed for any reason, all processing error messages are logged and the message can be either forwarded to the user's mailbox or saved, depending on installation options.

Each site operating an autoDRM places restrictions on the size of the email response to the user. In order to facilitate email transfer of large responses, some sites employ the CONTINUE command, which is part of the GSE2.0 autoDRM command set. The `.deliver` script can handle autoDRM responses that are continued over two or more separate email messages. Frequently, the individual messages of a continued response will arrive out of order. The `.deliver` script holds continued messages until the first message of the response, which contains the REF_ID, is received before processing all the continuations.

The waveform parsing program, `gse2css`, converts GSE2.0 WID2 headers and CM6 compressed waveform data to CSS3.0 format. An origin file is created from the event information input at request time. Individual waveform files are created for each channel following the naming convention of `sta.chan.epochaltime.w`. If a request is repeated, the incoming data will write over the older data if the sta, chan and epochal time are the same.

Another request program, `reqchan`, requests station and channel information from an autoDRM. When the `.deliver` script finds keywords DATA_TYPE STATION or DATA_TYPE CHANNEL in the autoDRM response, a different conversion program, named `gse2site`, is executed. `Gse2site` creates or updates the system's CSS3.0 site and sitechan tables if new station and/or channel information arrives from an autoDRM.

ReqData supports multiple, simultaneous users. A CSS3.0 lastid table-file is updated with orid, wfid, chanid and msgid records. A central request-file logs request-ids for all users. A Unix file locking mechanism insures that all files being written to by

the message conversion programs, including lastid, origin, wfdisc, status and data files, are updated correctly. This is necessary not only to allow multiple users, but even for a single user, since the processing of sequentially arriving email messages can overlap in time, resulting in the execution of multiple instances of the conversion programs.

INSTALLATION

Getting The Package

The ReqData package can be obtained by anonymous FTP from es2.multimax.com. In the directory `pub/gtdb/reqdata`, you will find compressed tar files containing executables for SunOS-4.1.3, Sun-5.3 (Solaris-2.3), and IRIX-5.3:

```
reqdata1.0.bin.sun4.1.3.Z

reqdata1.0.bin.sun5.3.Z

reqdata1.0.bin.irix5.3.Z
```

These tar files also contain tables of station locations, travel times and autoDRM addresses. This document is included as a PostScript file, and there are Unix "man" pages for the programs. The complete source code is also available as a separate compressed tar file:

```
reqdata1.0.src.Z
```

The directories in the ReqData package (excluding the source) are:

```
reqdata/bin

reqdata/continued

reqdata/doc

reqdata/info

reqdata/logs

reqdata/man/man1
```

reqdata/man/man3

reqdata/man/man5

reqdata/save

reqdata/tables/static

reqdata/tables/dynamic

Install this directory tree in a location available to all users and make sure that the directories tables/dynamic, logs, continued, and save are writable by all users of the package. Add reqdata/bin to each user's PATH environment variable and add reqdata/man to the MANPATH environment variable. Each user must also set the environment variable REQDATA_HOME to the location of the reqdata directory.

Activating Automatic Email Parsing

There are just a few steps necessary to activate the automatic parsing of GSE-formatted email. First, edit the file reqdata/.deliver and change the line REQDATA_HOME=/path/reqdata to be the actual location of the reqdata directory. Then copy reqdata/.deliver to each user's home directory (or make a link to it). Create a file named .forward in each user's home directory containing the line:

"|*/path*/reqdata/bin/deliver *username* || exit 75".

Include the quotes. Substitute for */path*/reqdata the actual location of reqdata and substitute for *username* the user's login name. Mail must be deliverable locally to username, so it cannot be an address to another machine (No @). If the user's mailbox file is not in the directory /var/spool/mail, then specify the mailbox directory with a -m option. For example, if the user's mailbox file is in the directory /var/mail, then create a .forward file with:

"|*/path*/reqdata/bin/deliver *username* -m /var/mail || exit 75".

Leave a space between the -m and /var/mail.

The .forward file will instruct the Unix mail receiving program (sendmail) to execute the deliver program and pass all email to it. The deliver program will use the .deliver script to detect GSE formatted mail and execute the appropriate

parsing program. If `reqdata/bin/deliver` is unavailable (perhaps because a file server is down or an automounter failed), the "`|| exit 75`" in the `.forward` file instructs `sendmail` to requeue mail for later delivery. Normally, this is a sufficient safeguard against bouncing mail back to an autoDRM. But if the `deliver` program is unavailable for a long time (more than a few hours), `sendmail` will reply to senders that it is having a delivery problem and eventually return messages to senders.

Optional Installation Step

The following optional installation step will prevent mail from being returned to the sender when the `deliver` program is unavailable for a long time. Instead of requeueing messages, we can instruct the `sendmail` program to bypass the `.forward` file and send mail directly to the user's mailbox whenever the `deliver` program is unavailable. First remove the "`|| exit 75`" from the `.forward` file. Edit the `sendmail` aliases file, usually `/etc/aliases`. (You will probably need root permission to edit this file. If it is not in `/etc`, check for its location in the configuration file `/etc/sendmail.cf`.) Look for a line in `/etc/aliases` that begins with *username*:, where *username* is your login name. After that line, add (substituting your login name for *username*):

`owner-`*username*: *username*

If there isn't a line beginning with *username*:, then add the following two lines to the file:

username: *username*

`owner-`*username*: *username*

The "`owner-`*username*:" line in the aliases file will prevent email from being bounced back to the sender, in the event that the `deliver` program is unavailable or fails to execute correctly. If `deliver` fails for any reason, `sendmail` will send the mail along with an error message directly to the user's mailbox.

Testing The Installation

It is a good idea to test the installation "locally" before sending a request to an autoDRM. After you have completed the installation steps of the previous section (installed the `reqdata` directory, edited and installed the `.deliver` and `.forward` files), try the following test:

```
setenv REQDATA_HOME /path/reqdata

cd /path/reqdata

bin/reqdata par=test_parfile
```

The file `test_parfile` contains:

```
stachanlist=AAE/B*

address=user

retaddr=me@mymachine.address

basedir=/tmp/test_reqdata

time=96/06/19 00:18:02

lat=36.11

lon=35.80

depth=10.0
```

This will instruct `reqdata` to form a request and mail it to you. Check your mail for the test request message. If you do not receive it after a few moments, look in `logs/deliver.log` for error messages and check the mail queue to see if the test message could not be delivered. If you do receive the test request message, you can delete it and continue. Check to see if the directory `/tmp/test_reqdata` was created, and if it is there, proceed with:

```
bin/reqstat /tmp/test_reqdata &
```

The `reqstat` main window should display one event in its `Requested Events` list with status "waiting" and prefix "test_reqdata". Select the event with a mouse click and select the **Stations...** button to display the channel listing. There should be three lines for `AAE` and channels `BHE`, `BHN` and `BHZ`.

Continue the test of the mail parsing programs by mailing a GSE-formatted message to yourself:

```
mail username < test_msg
```

After a few seconds, the `reqstat` status fields for channels `BHN` and `BHZ` should change to "response", and the files

```
/tmp/test_reqdata/w/AAE.BHE.835143783.02.w

/tmp/test_reqdata/w/AAE.BHZ.835143783.02.w
```

should be created. If they are there, the installation is good.

SENDING REQUESTS WITH `ReqData`

Basic Operation

The program `reqdata` requests waveform data from one or more autoDRM's, given an approximate event time and location and a list of stations. This information can be input on the command line, or the user can place arguments in a file and input the filename on the command line with `reqdata par=parfile`. A simple `parfile` for `reqdata` looks like:

```
retaddr=username@myaddress

basedir=/disk1/data/event01

stachanList=AAM/*,ALQ/B*,BLA/BHZ,NORES/*,ESDC/b*

time=96/05/13 04:53:47

lat=7.19N

lon=76.88W

depth=27.0
```

Specify your email address with the `retaddr` argument, and specify the directory where the data will be installed with the `basedir` argument. The `stachanList` argument is a list of station/channel or network/element pairs. The list can contain the '*' wildcard character as the final character of the channel or array element name. When a wildcard character is encountered, the program first searches the affiliation table `$REQDATA_HOME/tables/static/global.affiliation` for a matching network name. In the example above, `NORES/*` will expand to include all the elements of

the NORES array and all the channels of each element. Array expansion can also be limited. In the example above, ESDC/b* expands to include only the broad-band channels at the ESDC array: ESLA/BHZ, ESLA/BHN, ESLA/BHE. The program also searches the sitechan file $REQDATA_HOME/tables/static/global.sitechan for a matching station name, and if found expands the '*' character to include all channels for the matching station. AAM/* expands to include all channels AAM/HLZ, AAM/HLN, AAM/HLE, AAM/BLZ, AAM/BLN, AAM/BLE, AAM/LLZ, AAM/LLN, AAM/LLE, whereas ALQ/B* expands to only the broadband channels ALQ/BHZ, ALQ/BHN, ALQ/BHE. Station and channels names are case insensitive, so for example, you could specify alq/b* instead of ALQ/B*.

Input an approximate event time and location with the arguments time, lat, lon and depth. The format for time is yyyy/mm/dd hh:mm:ss.s, but reqdata also recognizes a two digit year-1900, as shown above, or an epochal time as in CSS3.0 origin tables. Input the latitude and longitude using N, S, E, W for north, south, east or west or input a positive number for north and east and negative number for south and west.

Reqdata searches $REQDATA_HOME/tables/static/global.site for station locations and computes request time windows. The default time window for each station starts one minute before the first P arrival time and ends 30 minutes after the LR arrival. The user can change the default by using the optional arguments begPhase and endPhase. The format for these arguments is phase+/-seconds. Using this format, the default time window looks like:

```
begPhase=P-60.

endPhase=LR+1800.
```

To request a four-minute time window centered on the P arrival time, for example, add the following lines to the parfile:

```
begPhase=P-120.

endPhase=P+120.
```

Other standard phases in the IASPEI table are also recognized for begPhase and endPhase.

Once reqdata has computed time windows for all station/channel pairs, it searches the address file $REQDATA_HOME/tables/static/global.address for the address of

an autoDRM associated with each individual channel. The address file contains free-formatted lines with `sta`, `chan`, `address`, `format` information. For example, the following lines

```
ALQ BHZ autodrm@gldfs.cr.usgs.gov GSE2.0
ALQ BHN autodrm@gldfs.cr.usgs.gov GSE2.0
ALQ BHE autodrm@gldfs.cr.usgs.gov GSE2.0
NRA0 she messages@cdidc.org GSE2.0
NRA0 shn messages@cdidc.org GSE2.0
NRA0 shz messages@cdidc.org GSE2.0
NRA1 shz messages@cdidc.org GSE2.0
NRA1 shz messages@cdidc.org GSE2.0
...
```

instruct `reqdata` to request `ALQ` broadband channels from `autodrm@gldfs.cr.usgs.gov` and request `NORES` channels from `messages@cdidc.org`. If two different addresses are listed in the address file for one station/channel, `reqdata` uses the first line encountered.

Optional Arguments to ReqData

`stachanFile` This optional argument can be used in place of `stachanList` to specify a list of stations and channels to request. Simply list the station/channel and network/element pairs in a file, one pair per line, and input the filename using `stachanFile=filename`. Only the first two columns of this file are used by `reqdata`. Everything on the line after the channel name is ignored. The wildcard character can be used in the file. The '#' character can be used to comment-out lines. This allows one to easily use a channel listing obtained from an autoDRM (see `reqchan` below) as a `stachanFile`, which might look like:

```
#autodrm@gldfs.cr.usgs.gov
#Sta Chan Aux  Latitude  Longitude  Elev   Depth  Hang  Vang
AAE  BHZ IU   9.02917   38.76556   2.442  0.000   0.0   0.0
AAE  BHN IU   9.02917   38.76556   2.442  0.000   0.0  90.0
AAE  BHE IU   9.02917   38.76556   2.442  0.000  90.0  90.0
AAE  LHZ IU   9.02917   38.76556   2.442  0.000   0.0   0.0
AAE  LHN IU   9.02917   38.76556   2.442  0.000   0.0  90.0
AAE  LHE IU   9.02917   38.76556   2.442  0.000  90.0  90.0
```

```
AAM  HLZ US   42.29972  -83.65611   0.249  0.000   0.0   0.0
AAM  HLN US   42.29972  -83.65611   0.249  0.000   0.0  90.0
AAM  HLE US   42.29972  -83.65611   0.249  0.000  90.0  90.0
AAM  BLZ US   42.29972  -83.65611   0.249  0.000   0.0   0.0
AAM  BLN US   42.29972  -83.65611   0.249  0.000   0.0  90.0
AAM  BLE US   42.29972  -83.65611   0.249  0.000  90.0  90.0
...
```

`prefix` When `reqdata` is executed it creates the files `prefix.reqlog` and `prefix.reqstatus` in the directory specified by `basedir`. When `gse2css` processes a response to the data request, it creates `prefix.origin` and `prefix.wfdisc` in the same directory. The default value of `prefix` is the directory name. For example, the `parfile` above would cause the following files to be created.

```
/disk1/data/event01/event01.reqlog
/disk1/data/event01/event01.reqstatus
/disk1/data/event01/event01.origin
/disk1/data/event01/event01.wfdisc
```

`dir` This is the directory where waveform files are installed using the naming convention `sta.chan.epochal_time.w`. It is relative to `basedir`, if it does not begin with '/'. The default for `dir` is `w`. Before it sends any requests, `reqdata` confirms that the data directory exists or can be created.

`mb` This body wave magnitude is recorded in the `prefix.origin` file.

`ms` This surface wave magnitude is recorded in the `prefix.origin` file.

`ml` This local magnitude is recorded in the `prefix.origin` file.

`origin` An alternative method of specifying the event time and location is to input a free-formatted CSS3.0 origin record with the `origin` argument. All the fields of the origin record must be specified (null values may be substituted), and they will be recorded in the `prefix.origin` file. The `origin` argument can also be set to the name of a file containing one or more CSS3.0 origin records. Data requests will be made for each origin in the file.

`maxChan` The maximum number of channels per email request. The default is 3 channels. Three email requests will be sent for a station that has 9 channels.

`address` If this argument is specified, all requests will be sent to the value of `address`, and `$REQDATA_HOME/tables/static/global.address` will not be used.

`ttonly` If this argument is set to 1, the start and end times of each waveform that would be requested are printed, but no requests are sent.

`verbose` Controls information printed during execution. Set to 0, 1 or 2.

`start_time` Overrides `begPhase` for the computation of the requested waveform start times. If specified, this will be the start time of all waveforms requested for all stations.

`end_time` Overrides `endPhase` for the computation of the requested waveform end times. If specified, this will be the end time of all waveforms requested for all stations.

`sendmail` The location of the `sendmail` program can be specified with this argument. The default value is `/usr/lib/sendmail`. (`Sendmail` is a standard Unix mail daemon, responsible for routing mail.)

`sleep` Time in seconds that `reqdata` sleeps between executions of `sendmail`. Defaults to two. A sleep is frequently necessary to prevent mail queues from filling up or prevent exhausting other Unix system resources, such as total number of processes.

`tableDir` This is the directory containing the two subdirectories `static` and `dynamic` with table-files used by `reqdata` and associated programs. If `tableDir` is not specified, the directory `$REQDATA_HOME/tables` will be used. The following files are needed by `reqdata`:

```
static/global.address
static/global.affiliation
static/global.site
static/global.sitechan
static/iasp91.hed
static/iasp91.tbl
```

and the following files will be created by `reqdata` or conversion programs:

```
dynamic/global.lastid
dynamic/global.request
dynamic/global.continued
```

`addressTable` Overrides the default address-table file.

`affiliationTable` Overrides the default affiliation-table file.

`siteTable` Overrides the default site-table file.

`sitechanTable` Overrides the default sitechan-table file.

`iaspeiTable` Overrides the default IASPEI table prefix.

`lastidTable` Overrides the default lastid-table file.

`requestTable` Overrides the default request-table file.

Updating Station Information with reqchan

The ReqData package comes with `global.site`, `global.sitechan`, `global.address` and `global.affiliation` files which contain station and channel information for several autoDRM sites. If the user wishes to request data from stations at a new autoDRM site, the program `reqchan` can be used to update all of these station files, except `global.affiliation`. Another use for the `reqchan` program is to update the station files for any autoDRM site to catch new stations that may have been added to the site's database. A simple `parfile` for `reqchan` looks like:

```
retaddr=username@myaddress

address=autodrm_name@autodrm_address

log=logfile
```

`Reqchan` sends a request for a complete station and channel listing to the specified autoDRM. The response is processed by the program `gse2site`, which creates or updates the `site`, `sitechan` and `address` files. The response is also forwarded to the user's mailbox, so it can be saved for use as `stachanFile` input to `reqdata`.

MANAGING REQUESTS WITH REQSTAT

Basic Operation

When data requests are made by `reqdata`, the files `prefix.reqlog` and `prefix.reqstatus` are created in the `basedir` directory. For the example `reqdata parfile` shown above, the following two files would be created:

```
/disk1/data/event01/event01.reqlog

/disk1/data/event01/event01.reqstatus
```

The information in these files can be reviewed with the program `reqstat`. You can execute `reqstat` with no command line arguments, with a `.reqstatus` file, or with a directory name. For example, the following are valid execution statements:

```
reqstat

reqstat /disk1/data/event01/event01.reqstatus

reqstat /disk1/data
```

If no files or directories are on the command line, the user has the option to input `.reqstatus` files with the **File/Open** option, discussed below. If `reqstat` is executed with a filename as a command line argument, it reads the contents of that file only. On the other hand, if a directory name is input on the command line, `reqstat` recursively searches for all `.reqstatus` files in the input directory and in all subdirectories beneath the input directory.

Figure 1 shows the main window of `reqstat` displaying a list of requested events. In addition to the status of each event request, other information about the event is displayed including time, location, date requested, and all fields in the origin table-file. The **status** field displays "done" when autoDRM responses have been received for each individual station request associated with the event.

The status of individual stations will be displayed in another window when the user selects an event line and selects the **Stations** option button. Figure 2 shows the `reqstat` station request window for one event. Each station/channel requested for the event is listed. The **status** field displays "**waiting**" or "**response**". The limits for the time window requested and the time window actually received are displayed. If no data has been received for a channel, the **received-tbeg** will display additional status information, such as **NO RESPONSE**, **NOT AVAILABLE** or **REQUEST ERROR**. The address of the autoDRM to which the request was sent is displayed along with the time of the last activity.

The `reqstat` station request window has a **Re-request** option that allows the user to re-request all selected channels, all channels with a **NO RESPONSE** status, or all channels with a **NOT AVAILABLE** status. The **Re-request** option generates a **Confirm Re-request** window that lists all the channels that will be re-requested and allows the user to edit the time window limits and the autoDRM address. Use

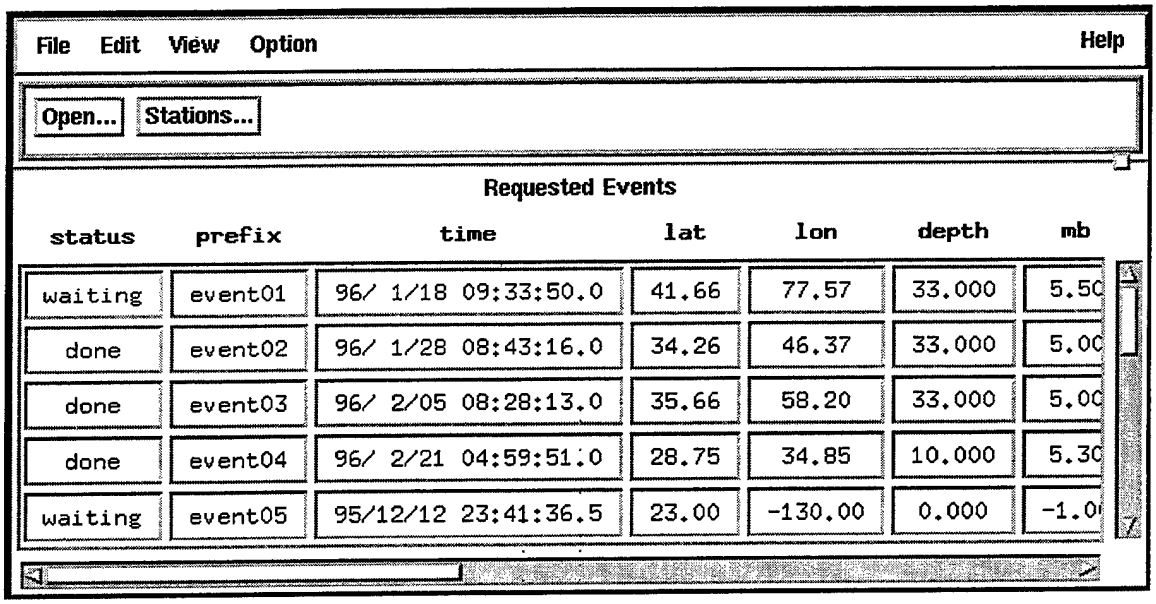


Figure 1: The main window of `reqstat`. All requested events are listed.

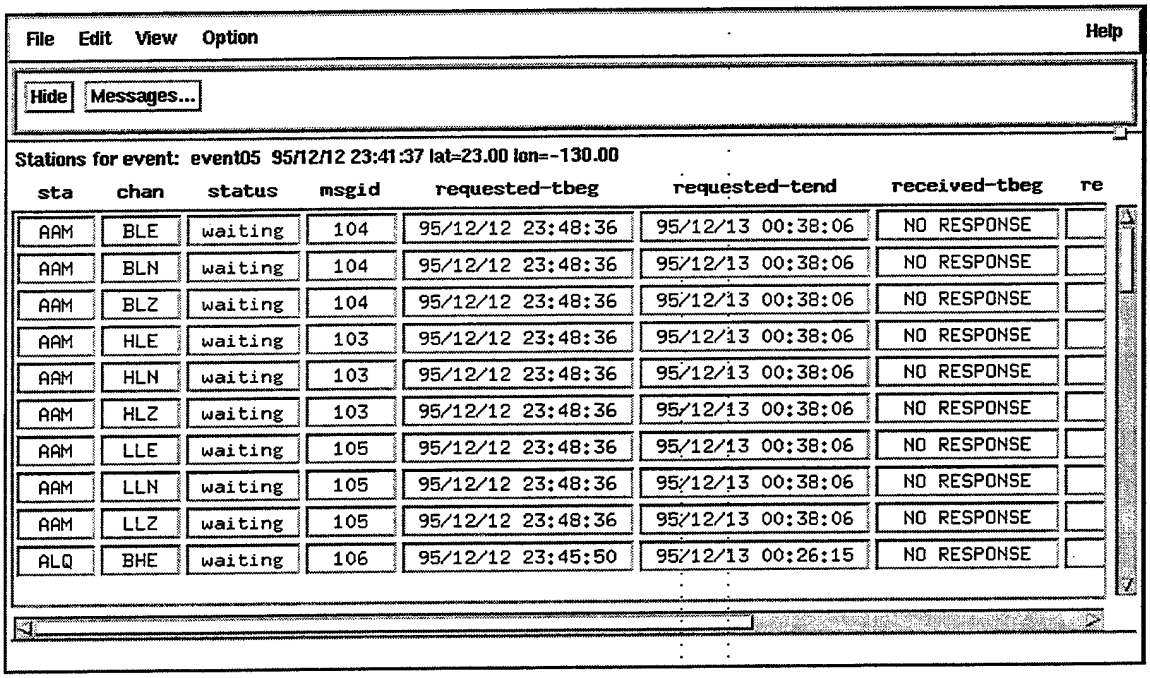


Figure 2: The `reqstat` station request window. The status of each station/channel request for one event is displayed.

a right-mouse-button click in any field of the **Confirm Re-request** window to enter edit mode. An autoDRM address can be entered for each channel or one can be selected from a list. After a re-request is confirmed, a new line for each channel re-requested is be added to the station request window.

From the `reqstat` station request window the Messages option can be used to display a copy of the exact autoDRM-formatted request that was sent and detailed information on the response that was received for the selected channel. Figure 3 shows an example of the content in a `reqstat` messages window. The time that `gse2css` was executed to process the autoDRM response is displayed followed by message identification lines and all `DATA_TYPE LOG` lines that were in the message.

Reqstat Options

All options for each `reqstat` window are listed below with a brief explanation of their function.

Main Window

File/Open Displays the standard X11 file selection popup. Select an individual `.reqstatus` file to view, or select a directory (double click on the directory name in the **Directories** list).

File/Warnings Displays a list of all warnings encountered.

View/Attributes This popup allows the user to customize the information displayed for each requested event. Click on an attribute **Name** to add or remove that attribute from the display line. Attributes can be reordered by deselecting all of them and then selecting in the order you want them displayed. Click in the **Format** field to edit the format used to display the attribute.

View/Clear Remove the current event listing from `reqstat`.

View/Sort Select the sort option for the events: sort by **Prefix**, by **Event Time** or by **Request Date**.

View/Stations Display the `reqstat` station request window for the selected event.

Option/Re-request This option will re-request stations for the selected events. There are two types of re-requests: re-request all stations for which no response has been received, or re-request all stations for which a **NO DATA**

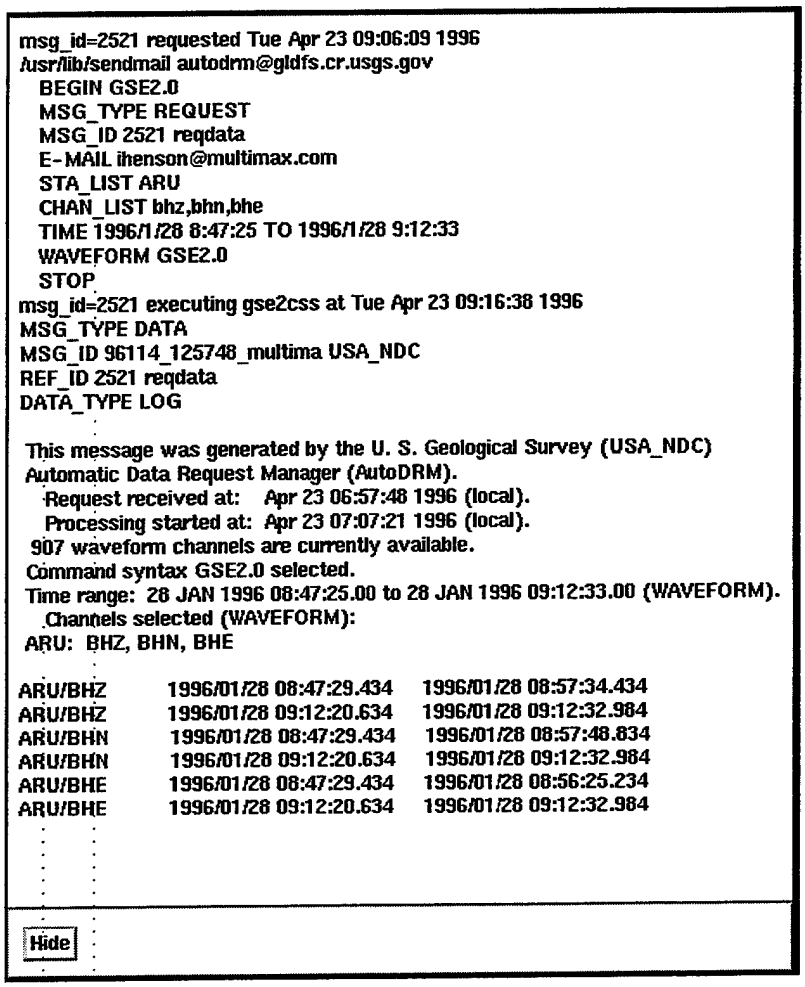


Figure 3: The `reqstat` messages window. A copy of the autoDRM-formatted request is followed by information resulting from the processing of the autoDRM response.

AVAILABLE response was received. Before the re-requests are actually sent, a **Confirm Re-request** window will list the channels that will be re-requested. The requested time limits and the autoDRM addresses can be changed before a **Confirm** option sends the re-requests. A **Cancel** button is also available.

Station Request Window

View/Attributes This popup allows the user to customize the information displayed for each requested station/channel. Click on an attribute **Name** to add or remove that attribute from the display line. The attributes can be reordered by deselecting all of them and then selecting each attribute in the order you want them displayed.

View/Messages Display the exact GSE-formatted request message that was sent to the autoDRM and display any **DATA_TYPE LOG** or **DATA_TYPE ERROR** messages received from the autoDRM. Error messages from `gse2css` are also displayed.

Option/Re-request This option will re-request data for the specified stations or channels. There are three types of re-requests: re-request all selected stations, re-request all stations for which no response has been received, or re-request all stations for which a **NO DATA AVAILABLE** response was received. Before the re-requests are actually sent, a **Confirm Re-request** window will display all the stations and channels that will be re-requested along with **Confirm** and **Cancel** buttons. The requested time limits and the autoDRM addresses can be changed in the **Confirm Re-request** window.

Confirm Re-request Window

This window is generated by a **Re-request** option from either the `reqstat` main window or the stations request window. The time limits of the re-request, **tbeg** and **tend**, and the autoDRM **address** can be changed before confirming the re-request. Enter edit-mode with a right-mouse-button click in any text field. The **Address** option is a tool for changing the autoDRM address for multiple channels in the **Confirm Re-request** window. First select channels in the **Confirm Re-request** window with a left-mouse-button (or ctrl-left-mouse-button) click. Enter an address in the **Enter New Address** text field of the **Address** popup or select one from the list of autoDRM sites. The list of autoDRM addresses is generated from the unique addresses in the `$REQDATA_HOME/tables/static/global.address` file.

HANDLING ERRORS

Error messages from `reqdata` and `reqchan` are written directly to the screen (stderr). Most of the errors are caused by missing arguments, missing table files, invalid file permissions or invalid file formats. The fatal errors from the programs `reqdata` and `reqchan` and the exit codes generated are listed in the following two tables.

Code	reqdata Errors
1	Missing argument retaddr
2	Missing argument basedir
3	Invalid time argument
4	Missing stachanList or stachanFile argument
5	No stations or channels found in stachanFile
6	No stations or channels found in stachanList
7	Invalid begPhase argument
8	Invalid endPhase argument
9	No iaspeiTable specified
10	No siteTable specified
11	No sitechanTable specified
12	No affiliationTable specified
13	No addressTable specified
14	No lastidTable specified
15	No requestTable specified
16	Cannot open iaspeiTable.hed
17	Cannot open iaspeiTable.tbl
18	Cannot open tmpfile
19	CSS3.0 origin free-format error in origin input string
20	Origin time value missing or null
21	Origin lat value missing or null
22	Origin lon value missing or null
23	Origin depth value missing or null
24	Cannot open origin input file
25	Malloc error.
26	CSS3.0 origin format error in origin input file
27	Cannot stat origin input file
28	No origins specified
29	Both stachanList and stachanFile specified
30	Cannot open stachanFile

Code	reqdata Errors Continued
31	Cannot stat affiliationTable
32	Cannot open affiliationTable
33	CSS3.0 Format error in affiliationTable
34	Cannot stat sitechanTable
35	Cannot open sitechanTable
36	CSS3.0 format error in sitechanTable
37	Cannot open addressTable
38	Cannot stat siteTable
39	Cannot open siteTable
40	CSS3.0 format error in siteTable
41	Requested station not found in siteTable
42	No autoDRM address for requested sta/chan
43	Unknown format field in addressTable
44	Cannot open requestTable
45	No travel time for begPhase at requested station
46	No travel time for endPhase at requested station
47	Cannot open prefix.reqstatus file
48	Cannot open prefix.reqlog file
49	Error computing travel time
50	Error getting nextid
51	Cannot execute sendmail program
52	Sendmail program failed

Code	reqchan Errors
1	Missing argument retaddr
2	Missing argument address
3	No lastidTable specified
4	No requestTable specified
5	Cannot open requestTable
6	Cannot open log file
7	Cannot get nextid
8	Cannot execute sendmail program
9	Sendmail program failed

When an error occurs during the processing of an autoDRM email response, the error is logged and the email response is saved. The message can be saved in a file or forwarded to the user's mailbox. To instruct the `deliver` program to forward all email that fails to be processed to the user's mailbox, set the variable `FORWARD_FAILED_MSG` to 'yes' in the `.deliver` script.

```
FORWARD_FAILED_MSG=yes
```

By default, autoDRM email that is successfully processed is discarded. To save all autoDRM email messages, set the variable `SAVE_ALL_GSE_MESSAGES` to 'yes' in the `.deliver` script.

```
SAVE_ALL_GSE_MESSAGES=yes
```

Each autoDRM message will then be saved in a separate file in the directory `$REQDATA_HOME/save`.

An error in the `.deliver` script which prevents the processing of all messages, causes a description of the error to be mailed to the user. Other less severe errors encountered by the `.deliver` script are logged in the file `$REQDATA_HOME/logs/deliver.log`. Error messages from the message parsing program `gse2css` are logged in the `prefix.reqlog` file in the `basedir` directory. These can be reviewed with the program `reqstat`. Error messages from the autoDRM are also logged in the `prefix.reqlog` file. The fatal errors from the programs `gse2css` and `gse2site` and the exit codes generated are listed in the following two tables.

Code	gse2css Errors
1	Cannot open reqLog
2	Missing argument basedir
3	Missing argument prefix
4	Missing argument dir
5	Length of argument dir > 64
6	Missing argument lastidTable
7	Cannot open input file
8	Cannot open reqstatus file
9	Cannot open tmpfile
10	CSS3.0 origin format error
11	Get nextid failed
12	Cannot open .origin file
13	Write to .origin file failed
14	Cannot open .wfdisc file
15	GSE WID1 format error
16	GSE WID2 format error
17	No GSE WID header found
18	Malloc error
19	GSE CHK2 line not found
20	Unknown compression format
21	Cannot open dfile (.w file)
22	Write to .wfdisc file failed
23	Write to dfile failed

Code	gse2site Errors
1	Missing argument address
2	Missing argument lastidTable
3	Missing argument siteTable
4	Missing argument sitechanTable
5	Missing argument addressTable
6	Cannot open input file
7	Cannot open logFile
8	Cannot open siteTable
9	Malloc error
10	CSS3.0 format error in siteTable
11	Cannot open sitechanTable
12	CSS3.0 format error in sitechanTable
13	Cannot open addressTable
14	Format error in addressTable
15-19	Error parsing DATA_TYPE STATION
20	Write to siteTable failed
21-25	Error parsing DATA_TYPE CHANNEL
26	Write to sitechanTable failed
27	Write to addressTable failed

ACKNOWLEDGMENTS

ReqData was designed and tested primarily with the autoDRM currently implemented by USGS (autodrm@gldfs.cr.usgs.gov). The authors gratefully acknowledge the help of Ray Buland in testing ReqData. This project was funded through grant F19628-95-C-0094.

REFERENCE LIST

Anderson, J., W. E. Farrell, K. Garcia, J. Given, H. Swanger (1990). Center for Seismic Studies Version 3 Database: Schema Reference Manual, TR C90 -01, September 1990.

Kradolfer, U. (1993). Automating the Exchange of Earthquake Information, *EOS Trans. Amer. Geophys. U.*, **74**, 442.

GSE Conference Room Paper 243 Concept for GSE Messages.

THOMAS AHRENS
SEISMOLOGICAL LABORATORY 252-21
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CA 91125

SHELTON ALEXANDER
PENNSYLVANIA STATE UNIVERSITY
DEPARTMENT OF GEOSCIENCES
537 DEIKE BUILDING
UNIVERSITY PARK, PA 16801

RICHARD BARDZELL
ACIS
DCI/ACIS
WASHINGTON, DC 20505

DOUGLAS BAUMGARDT
ENSCO INC.
5400 PORT ROYAL ROAD
SPRINGFIELD, VA 22151

WILLIAM BENSON
NAS/COS
ROOM HA372
2001 WISCONSIN AVE. NW
WASHINGTON, DC 20007

ROBERT BLANDFORD
AFTAC
1300 N. 17TH STREET
SUITE 1450
ARLINGTON, VA 22209-2308

RHETT BUTLER
IRIS
1616 N. FORT MEYER DRIVE
SUITE 1050
ARLINGTON, VA 22209

CATHERINE DE GROOT-HEDLIN
SCRIPPS INSTITUTION OF OCEANOGRAPHY
UNIVERSITY OF CALIFORNIA, SAN DIEGO
INSTITUTE OF GEOPHYSICS AND PLANETARY PHYSICS
LA JOLLA, CA 92093

SEAN DORAN
ACIS
DCI/ACIS
WASHINGTON , DC 20505

RICHARD J. FANTEL
BUREAU OF MINES
DEPT OF INTERIOR, BLDG 20
DENVER FEDERAL CENTER
DENVER, CO 80225

RALPH ALEWINE
NTPO
1901 N. MOORE STREET, SUITE 609
ARLINGTON, VA 22209

MUAWIA BARAZANGI
INSTITUTE FOR THE STUDY OF THE CONTINENTS
3126 SNEE HALL
CORNELL UNIVERSITY
ITHACA, NY 14853

T.G. BARKER
MAXWELL TECHNOLOGIES
P.O. BOX 23558
SAN DIEGO, CA 92123

THERON J. BENNETT
MAXWELL TECHNOLOGIES
11800 SUNRISE VALLEY DRIVE SUITE 1212
RESTON, VA 22091

JONATHAN BERGER
UNIVERSITY OF CA, SAN DIEGO
SCRIPPS INSTITUTION OF OCEANOGRAPHY IGPP, 0225
9500 GILMAN DRIVE
LA JOLLA, CA 92093-0225

STEVEN BRATT
NTPO
1901 N. MOORE STREET, SUITE 609
ARLINGTON, VA 22209

LESLIE A. CASEY
DOE
1000 INDEPENDENCE AVE. SW
NN-40
WASHINGTON, DC 20585-0420

STANLEY DICKINSON
AFOSR
110 DUNCAN AVENUE, SUITE B115
BOLLING AFB
WASHINGTON, D.C. 20332-001

DIANE I. DOSER
DEPARTMENT OF GEOLOGICAL SCIENCES
THE UNIVERSITY OF TEXAS AT EL PASO
EL PASO, TX 79968

JOHN FILSON
ACIS/TMG/NTT
ROOM 6T11 NHB
WASHINGTON, DC 20505

MARK D. FISK
MISSION RESEARCH CORPORATION
735 STATE STREET
P.O. DRAWER 719
SANTA BARBARA, CA 93102-0719

LORI GRANT
MULTIMAX, INC.
311C FOREST AVE. SUITE 3
PACIFIC GROVE, CA 93950

I. N. GUPTA
MULTIMAX, INC.
1441 MCCORMICK DRIVE
LARGO, MD 20774

JAMES HAYES
NSF
4201 WILSON BLVD., ROOM 785
ARLINGTON, VA 22230

MICHAEL HEDLIN
UNIVERSITY OF CALIFORNIA, SAN DIEGO
SCRIPPS INSTITUTION OF OCEANOGRAPHY IGPP, 0225
9500 GILMAN DRIVE
LA JOLLA, CA 92093-0225

EUGENE HERRIN
SOUTHERN METHODIST UNIVERSITY
DEPARTMENT OF GEOLOGICAL SCIENCES
DALLAS, TX 75275-0395

VINDELL HSU
HQ/AFTAC/TTR
1030 S. HIGHWAY A1A
PATRICK AFB, FL 32925-3002

RONG-SONG JIH
PHILLIPS LABORATORY
EARTH SCIENCES DIVISION
29 RANDOLPH ROAD
HANSCOM AFB, MA 01731-3010

LAWRENCE LIVERMORE NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 808, MS L-200
LIVERMORE, CA 94551

LAWRENCE LIVERMORE NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 808, MS L-221
LIVERMORE, CA 94551

ROBERT GEIL
DOE
PALAIS DES NATIONS, RM D615
GENEVA 10, SWITZERLAND

HENRY GRAY
SMU STATISTICS DEPARTMENT
P.O. BOX 750302
DALLAS, TX 75275-0302

DAVID HARKRIDER
PHILLIPS LABORATORY
EARTH SCIENCES DIVISION
29 RANDOLPH ROAD
HANSCOM AFB, MA 01731-3010

THOMAS HEARN
NEW MEXICO STATE UNIVERSITY
DEPARTMENT OF PHYSICS
LAS CRUCES, NM 88003

DONALD HELMBERGER
CALIFORNIA INSTITUTE OF TECHNOLOGY
DIVISION OF GEOLOGICAL & PLANETARY SCIENCES
SEISMOLOGICAL LABORATORY
PASADENA, CA 91125

ROBERT HERRMANN
ST. LOUIS UNIVERSITY
DEPARTMENT OF EARTH & ATMOSPHERIC SCIENCES
3507 LACLEDE AVENUE
ST. LOUIS, MO 63103

ANTHONY IANNACCHIONE
BUREAU OF MINES
COCHRANE MILL ROAD
PO BOX 18070
PITTSBURGH, PA 15236-9986

THOMAS JORDAN
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
EARTH, ATMOSPHERIC & PLANETARY SCIENCES
77 MASSACHUSETTS AVENUE, 54-918
CAMBRIDGE, MA 02139

LAWRENCE LIVERMORE NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 808, MS L-207
LIVERMORE, CA 94551

LAWRENCE LIVERMORE NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
LLNL
PO BOX 808, MS L-175
LIVERMORE, CA 94551

LAWRENCE LIVERMORE NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 808, MS L-208
LIVERMORE, CA 94551

LAWRENCE LIVERMORE NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 808, MS L-202
LIVERMORE, CA 94551

LAWRENCE LIVERMORE NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 808, MS L-195
LIVERMORE, CA 94551

LAWRENCE LIVERMORE NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 808, MS L-205
LIVERMORE, CA 94551

THORNE LAY
UNIVERSITY OF CALIFORNIA, SANTA CRUZ
EARTH SCIENCES DEPARTMENT
EARTH & MARINE SCIENCE BUILDING
SANTA CRUZ, CA 95064

ANATOLI L. LEVSHIN
DEPARTMENT OF PHYSICS
UNIVERSITY OF COLORADO
CAMPUS BOX 390
BOULDER, CO 80309-0309

DONALD A. LINGER
DNA
6801 TELEGRAPH ROAD
ALEXANDRIA, VA 22310

LOS ALAMOS NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 1663, MS F659
LOS ALAMOS, NM 87545

LOS ALAMOS NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 1663, MS F665
LOS ALAMOS, NM 87545

LOS ALAMOS NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 1663, MS D460
LOS ALAMOS, NM 87545

LOS ALAMOS NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 1663, MS C335
LOS ALAMOS, NM 87545

GARY MCCARTOR
SOUTHERN METHODIST UNIVERSITY
DEPARTMENT OF PHYSICS
DALLAS, TX 75275-0395

KEITH MCLAUGHLIN
MAXWELL TECHNOLOGIES
P.O. BOX 23558
SAN DIEGO, CA 92123

BRIAN MITCHELL
DEPARTMENT OF EARTH & ATMOSPHERIC SCIENCES
ST. LOUIS UNIVERSITY
3507 LACLEDE AVENUE
ST. LOUIS, MO 63103

RICHARD MORROW
USACDA/IVI
320 21ST STREET, N.W.
WASHINGTON, DC 20451

JOHN MURPHY
MAXWELL TECHNOLOGIES
11800 SUNRISE VALLEY DRIVE SUITE 1212
RESTON, VA 22091

JAMES NI
NEW MEXICO STATE UNIVERSITY
DEPARTMENT OF PHYSICS
LAS CRUCES, NM 88003

CHARLES ODDENINO
BUREAU OF MINES
810 7TH ST. NW
WASHINGTON, DC 20241

JOHN ORCUTT
INSTITUTE OF GEOPHYSICS AND PLANETARY PHYSICS
UNIVERSITY OF CALIFORNIA, SAN DIEGO
LA JOLLA, CA 92093

PACIFIC NORTHWEST NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 999, MS K6-48
RICHLAND, WA 99352

PACIFIC NORTHWEST NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 999, MS K7-34
RICHLAND, WA 99352

PACIFIC NORTHWEST NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 999, MS K7-22
RICHLAND, WA 99352

PACIFIC NORTHWEST NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 999, MS K6-84
RICHLAND, WA 99352

FRANK PILOTTE
HQ/AFTAC/TT
1030 S. HIGHWAY A1A
PATRICK AFB, FL 32925-3002

JAY PULLI
RADIX SYSTEMS, INC.
6 TAFT COURT
ROCKVILLE, MD 20850

DAVID RUSSELL
HQ AFTAC/TTR
1030 SOUTH HIGHWAY A1A
PATRICK AFB, FL 32925-3002

SANDIA NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
DEPT. 5704
MS 0979, PO BOX 5800
ALBUQUERQUE, NM 87185-0979

SANDIA NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
DEPT. 5791
MS 0567, PO BOX 5800
ALBUQUERQUE, NM 87185-0567

SANDIA NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
DEPT. 5704
MS 0655, PO BOX 5800
ALBUQUERQUE, NM 87185-0655

SANDIA NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
DEPT. 6116
MS 0750, PO BOX 5800
ALBUQUERQUE, NM 87185-0750

PACIFIC NORTHWEST NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 999, MS K6-40
RICHLAND, WA 99352

PACIFIC NORTHWEST NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 999, MS K5-72
RICHLAND, WA 99352

PACIFIC NORTHWEST NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
PO BOX 999, MS K5-12
RICHLAND, WA 99352

KEITH PRIESTLEY
DEPARTMENT OF EARTH SCIENCES
UNIVERSITY OF CAMBRIDGE
MADINGLEY RISE, MADINGLEY ROAD
CAMBRIDGE, CB3 OEZ UK

PAUL RICHARDS
COLUMBIA UNIVERSITY
LAMONT-DOHERTY EARTH OBSERVATORY
PALISADES, NY 10964

CHANDAN SAIKIA
WOOODWARD-CLYDE FEDERAL SERVICES
566 EL DORADO ST., SUITE 100
PASADENA, CA 91101-2560

SANDIA NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
DEPT. 6116
MS 0750, PO BOX 5800
ALBUQUERQUE, NM 87185-0750

SANDIA NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
DEPT. 9311
MS 1159, PO BOX 5800
ALBUQUERQUE, NM 87185-1159

SANDIA NATIONAL LABORATORY
ATTN: TECHNICAL STAFF (PLS ROUTE)
DEPT. 5736
MS 0655, PO BOX 5800
ALBUQUERQUE, NM 87185-0655

THOMAS SERENO JR.
SCIENCE APPLICATIONS INTERNATIONAL
CORPORATION
10260 CAMPUS POINT DRIVE
SAN DIEGO, CA 92121

AVI SHAPIRA
SEISMOLOGY DIVISION
THE INSTITUTE FOR PETROLEUM RESEARCH AND GEOPHYSICS
P.O.B. 2286, NOLON 58122 ISRAEL

MATTHEW SIBOL
ENSCO, INC.
445 PINEDA COURT
MELBOURNE, FL 32940

JEFFRY STEVENS
MAXWELL TECHNOLOGIES
P.O. BOX 23558
SAN DIEGO, CA 92123

DAVID THOMAS
ISEE
29100 AURORA ROAD
CLEVELAND, OH 44139

LAWRENCE TURNBULL
ACIS
DCI/ACIS
WASHINGTON, DC 20505

FRANK VERNON
UNIVERSITY OF CALIFORNIA, SAN DIEGO
SCRIPPS INSTITUTION OF OCEANOGRAPHY IGPP, 0225
9500 GILMAN DRIVE
LA JOLLA, CA 92093-0225

DANIEL WEILL
NSF
EAR-785
4201 WILSON BLVD., ROOM 785
ARLINGTON, VA 22230

RU SHAN WU
UNIVERSITY OF CALIFORNIA SANTA CRUZ
EARTH SCIENCES DEPT.
1156 HIGH STREET
SANTA CRUZ, CA 95064

JAMES E. ZOLLWEG
BOISE STATE UNIVERSITY
GEOSCIENCES DEPT.
1910 UNIVERSITY DRIVE
BOISE, ID 83725

DEFENSE TECHNICAL INFORMATION CENTER
8725 JOHN J. KINGMAN ROAD
FT BELVOIR, VA 22060-6218 (2 COPIES)

ROBERT SHUMWAY
410 MRAK HALL
DIVISION OF STATISTICS
UNIVERSITY OF CALIFORNIA
DAVIS, CA 95616-8671

DAVID SIMPSON
IRIS
1616 N. FORT MEYER DRIVE
SUITE 1050
ARLINGTON, VA 22209

BRIAN SULLIVAN
BOSTON COLLEGE
INSITUTE FOR SPACE RESEARCH
140 COMMONWEALTH AVENUE
CHESTNUT HILL, MA 02167

NAFI TOKSOZ
EARTH RESOURCES LABORATORY, M.I.T.
42 CARLTON STREET, E34-440
CAMBRIDGE, MA 02142

GREG VAN DER VINK
IRIS
1616 N. FORT MEYER DRIVE
SUITE 1050
ARLINGTON, VA 22209

TERRY WALLACE
UNIVERSITY OF ARIZONA
DEPARTMENT OF GEOSCIENCES
BUILDING #77
TUCSON, AZ 85721

JAMES WHITCOMB
NSF
NSF/ISC OPERATIONS/EAR-785
4201 WILSON BLVD., ROOM785
ARLINGTON, VA 22230

JIAKANG XIE
COLUMBIA UNIVERSITY
LAMONT DOHERTY EARTH OBSERVATORY
ROUTE 9W
PALISADES, NY 10964

OFFICE OF THE SECRETARY OF DEFENSE
DDR&E
WASHINGTON, DC 20330

TACTEC
BATTELLE MEMORIAL INSTITUTE
505 KING AVENUE
COLUMBUS, OH 43201 (FINAL REPORT)

PHILLIPS LABORATORY
ATTN: XPG
29 RANDOLPH ROAD
HANSCOM AFB, MA 01731-3010

PHILLIPS LABORATORY
ATTN: TSML
5 WRIGHT STREET
HANSCOM AFB, MA 01731-3004

PHILLIPS LABORATORY
ATTN: GPE
29 RANDOLPH ROAD
HANSCOM AFB, MA 01731-3010

PHILLIPS LABORATORY
ATTN: PL/SUL
3550 ABERDEEN AVE SE
KIRTLAND, NM 87117-5776 (2 COPIES)